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ESTIMATING SHEAR-WAVE VELOCITY FROM SPT AND CPT DATA

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ABSTRACT

This report presents the investigation for developing improved regression equations for estimating shear-wave velocity from uncorrected or corrected penetration measurements. The proposed regression equations are developed from 103 data pairs of V_s and CPT, and V_s and SPT measurements collected from the United States, Japan, and Canada. The data pairs are collected primarily from (1) measurements compiled by Andrus et al. from sites that did and did not liquefy during large earthquakes, and (2) seismic CPT measurements performed by the United States Geological Survey in Alameda and Oakland, California. The proposed V_s-SPT regression equations developed in this study support the findings of earlier studies that blow count and depth, or overburden pressure, are significant influential parameters in V_s-SPT regression equations. The V_s-CPT regression analyses suggest that cone tip and sleeve resistances, depth or overburden pressure, and soil type are influential parameters in V_s-CPT regression equations. In addition, geologic age is found to be a significant parameter. Age scaling factors on the order of 1.3 are determined for the Pleistocene soils in Alameda and Oakland.

The proposed regression equations are evaluated with 73 data pairs based on seismic CPTs and crosshole measurements performed by Moh and Associates, Inc. following the 1999 Chi-Chi Taiwan earthquake. The results of the evaluation suggest that the proposed V_s-penetrations regression equations for Holocene soils will provide fairly good predictions of V_s for soils worldwide with an expected standard deviation of error of about 20 m/s. On the other hand, site-specific regression equations or age scaling factors should be developed for older deposits. For Taiwan soils deeper than 10 m, age scaling factors on the order of 1.26 are determined.

The proposed regression equations provide a viable way to estimate uncorrected V_s from penetration resistances for regional or preliminary ground response analysis, and also provide an approach to comparing liquefaction assessment procedures which are based on stress-corrected SPT, CPT or V_s measurements.